RESEARCH HIGHLIGHT

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# PERFORMANCE OF SPRAYED POLYURETHANE FOAM ON INDOOR FOUNDATION WALLS

## INTRODUCTION

More and more owners of existing homes are aware that home comfort and energy efficiency start with insulating basement foundation walls. Most choose traditional insulation methods using fibreglass batts, rigid insulation panels or a combination of these two materials. Homeowners can usually perform the work themselves. Others are choosing a less common, more expensive but more efficient technique—sprayed polyurethane foam insulation. This work must be done by a specialist in the field because it requires highly specialized equipment approved by the insulation's manufacturer.

Research already conducted by Canada Mortgage and Housing Corporation (CMHC) has shown that, for insulating foundation walls from the interior, sprayed polyurethane insulation offered some advantages over traditional insulation, such as its higher thermal resistance per inch of thickness, its greater airtightness, its resistance to air movement and to moisture.

Considering that foundation walls are often exposed to moisture and to water infiltration, there is some concern among construction and renovation stakeholders with regard to the behaviour of the sprayed polyurethane foam over the medium and long term when walls have been insulated from the inside.

## SCOPE OF THE RESEARCH

This is an expensive method of insulation. Is there reason to question the long-term performance of sprayed polyurethane foam on interior walls?

In order to shed some light on the question, this research evaluated the performance of spray polyurethane in terms of its efficiency and adhesion durability on different types of foundation walls (poured concrete and stonework) and on the quality of the foam five or more years after installation.

## METHOD

The research was conducted in accordance with standard protocol:

- setting a credible, representative sample of homes insulated with this product
- following a standardized inspection process

Home sampling and selection were performed in accordance with the following:

- sample of at least 12 homes
- two separate locations: Metropolitan Montréal area and the region of Gatineau
- foundation walls insulated more than five years ago
- walls are of variable composition, some stone foundation and some poured concrete
- full-height basement and crawl spaces

A standard data sheet was used to have a consistent, standardized inspection process from one house to another.

To know whether insulation adhesion might vary from one situation to another, it was important to check if the foundation walls had any water infiltration or moisture caused by poor site drainage, defective eavestroughs, a high water table or any other exterior problem.

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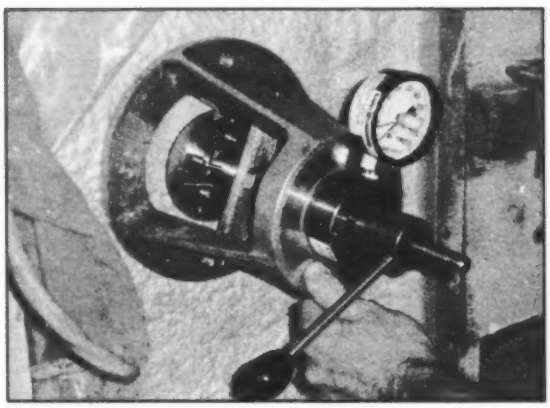
Also, it was important to note the type of foundation (poured concrete, stone or cement blocks) in order to determine whether the insulation behaved differently in each of these situations.

Adhesion tests were performed with a specialized instrument to ascertain whether the insulation provided acceptable adhesion to the foundation over time. To do so, two to four tests were performed in each house, at strategic sites:

- primarily in the lower part of the foundation wall (part below ground level), as close as possible to the basement or crawlspace floor
- in the upper part of the foundation wall (part above ground) to determine whether there were behaviour or adhesion differences between the part more exposed to moisture than the less exposed one.

The device used displayed a reading on a dial, expressed in kg, of the tear strength force required to detach the insulation from the foundation wall.

Before the tests, a researcher knocked on all the accessible, insulated wall surfaces to check whether there might be any cavities behind the insulation and to determine the location of the adhesion test sites.



## FINDINGS

Table 1 below is a summary of the key findings obtained from the 12 houses sampled and visited.

For the two homes in which results were poor (in Laval) and nil (in Outremont), it was obvious that the foundation walls were neither adequate nor in a condition suitable for this type of insulation. Indeed, in the first case, the foundation wall was of poor quality and damp. The owner indicated that the wall was friable and crumbling a bit before the insulation was applied. Therefore, the insulation appears to have been applied to a damp surface resulting in poor adhesion to the foundation. In the second case, the tests failed because the stone foundation had very friable parging. Despite this, the insulation remained well adhered to the walls over time; thus, there were no cavities between the insulation and the foundation walls.

In several homes, the insulation was not protected from fire as required by building codes, since it is a product with a high flame-spread rating. It would seem that installers of this type of insulation do not always advise their clients of this requirement. The insulation should be covered with gypsum or any other acceptable fire-retardant material.

## CONCLUSION

Based on the observations and tests performed on the 12 homes in the list, this research seems to confirm the reliability of polyurethane foam sprayed on the inside of foundation walls.

- In terms of adhesion, sprayed polyurethane behaves very well in the medium and long term.
- In terms of homogeneity and rigidity, polyurethane retains its cellular structure.
- The type of foundation wall (cement blocks, stone, poured concrete) does not affect adhesion rate when the insulation is applied under proper conditions, i.e., dry foundation.
- The green or yellow colouring of the insulation (yellow: before 1997 and green: after 1997) does not increase or decrease adhesion quality.
- Polyurethane on the inside wall does not behave differently above or below ground level.
- No separation or cracks occur between the insulation and wooden structural components and other adjacent materials (wooden joists, wooden or steel beams, wooden window frames, etc.).

Based on the poorest finding in Table 1, the insulation requires a minimum tear strength force of 117 kPa to detach it from the wall or to make it let go, while some required up to 248 kPa. These findings substantially exceed applicable standards for this insulation.

According to the homes checked, sprayed polyurethane foam insulation behaves very well in the medium and long term from the perspective of adhesion to foundations and adjacent materials and in terms of its ability to conserve its cellular properties and its homogeneity.

**Table 1. Summary of Findings**

| Location | Type of foundation | Colour of insulation | Thickness of insulation (mm) | Year of inst. | Adhesion test average (kPa) | Cellular structure | |
|---|---|---|---|---|---|---|---|
| | | | | | | Homogeneity | Rigidity |
| Duval St. Laval | Poured concrete | Yellow | 25 | Before 1991 | 33 | Uniform | Very firm |
| Dollard St. Hull | Poured concrete | Green | 38 & 44 | 1998 | 152 | Uniform | Very firm |
| Champlain St. Hull | Cement blocks | Green | Variable 32 & 38 | 1998 | 124 See Note 1 | Uniform | Very firm |
| Rodolphe St. Gatineau | Stone | Yellow | Variable 32 & 70 | 1998 | 145 See Note 1 | Uniform | Very firm |
| Angèle St. Bellefeuille | Poured concrete | Yellow | Variable 44 & 63 | 1994 | 248 | Uniform | Very firm |
| Marcil St. Laval | Poured concrete | Yellow | 50 | 1996 | 7 See Note 2 | Uniform | Very firm |
| Précourt St. St-Jérôme | Poured concrete | Yellow | Variable 1.25 to 2.0 | + 20 yrs | 172 | Uniform | Very firm |
| le Mesurier St. Montréal | Poured concrete | Yellow | Variable 32 & 63 | 1994 | 179 | Uniform | Very firm |
| Cr. Louise St. Mascouche | Poured concrete | Yellow | Variable 19 & 25 | 1996 | 117 | Uniform | Very firm |
| Chris-Ida St. Mascouche | Poured concrete | Green | 63 | 1997 | 214 | Uniform | Very firm |
| Maplewood St. Outremont, Mtl. | Stone | Yellow | 50 | + 10 yrs | See Note 3 | Uniform | Very firm |
| Lambert St. Oka | Poured concrete | Green | 50 | 1998 | 152 | Uniform | Very firm |

Note 1:

Although these are stone or cement block foundations, insulation adhesion is very good.

Note 2:

Out of all the houses tested, only this house obtained poor results. The foundation wall is of inferior quality and wet. The owner indicated that the wall was friable and crumbling a bit before the insulation was applied. The insulation therefore seems to have been applied on a damp surface, resulting in poor adhesion to the foundation.

Note 3:

The tests failed because the stone foundation had a very friable cement parging. Nevertheless, the insulation remained well-adhered to the walls; thus, there were no cavities between the insulation and the foundation walls.

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